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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in and relating to Temperature Responsive Control Apparatus

I, WELLESLEY ASHE KEALY, a British Subject, of Cherry House, The Avenue, Lymm, Cheshire, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to temperature responsive apparatus of the type including a temperature sensitive element connected through a liquid pressure transmitting conduit to a pressure-responsive device, the response of which is thereby a function of the sensed temperature. For convenience the temperature sensitive device will be referred to a sensor and the responding means, as it may be used to actuate some control means as an actuator. The sensor may include a fluid filled flexible capsule such as a bulb or bellows. The actuator may be another bulb or bellows, or a Bourdon tube. With an apparatus of this kind, in the course of manufacture the conduit is sealed to the temperature sensor and to the actuator, and the parts are filled with a liquid having a suitable coefficient of expansion or vapour pressure. In use, as the temperature sensor is heated the increase in pressure, or volumetric displacement of the liquid in the conduit, causes a corresponding movement of the actuator.

When sealed in this way to the temperature sensor and actuator difficulties arise in installing the conduit to pass through small apertures, and the fixed length of the conduit is inconvenient.

According to the present invention temperature sensitive apparatus comprising a sensor and an actuator and conduit means for joining the sensor and actuator on installation, and comprising liquid-tight deformable closure walls at the ends of the conduit, one wall being acted on by the sensor and the other being connected to the actuator, an opening at each end of the conduit to permit the space between said walls including said conduit to be filled with liquid and means for closing said openings.

Preferably the means for admitting liquid to the conduit comprises a valve which can be subsequently closed to seal the conduit. For example the valve may communicate with a duct through which flows a liquid whose flow is controlled by the actuator.

In a preferred form of the invention the apparatus includes means for adjusting the pressure of the liquid in the pressure conduit after it has been filled; such pressure adjusting means conveniently comprises a deformable capsule connected to the interior of the conduit, and mechanical means for adjusting the effective volume of the capsule.

The invention is applicable to temperature sensors of the bi-metallic or other types, in which changes in temperature produce an output force which can be applied to the respective deformable closure wall of the pressure conduit. The invention is however of particular advantage in cases where the sensor comprises a fluid-filled container such as a bulb, since it permits the use of a different fluid in the container from the liquid in the conduit. For example the fluid in the container may be methyl chloride, selected for its vapour pressure, while the liquid in the conduit may be water. In a preferred construction the closure wall of the pressure conduit at its end connected to the temperature sensor comprises a deformable capsule housed at least partly within the container.

Other features and advantages of the invention will appear from the following description of embodiments thereof, given by way of example, in conjunction with the accompanying drawings, in which:—

Figure 1 is a diagrammatic part-sectional view of a sensor,

Figure 2 is a sectional view of an actuator, for use with the sensor of Figure 1, and

[*Price 4s. 6d.*]

Figure 3 is a sectional view of an alternative form of actuator.

The apparatus shown in Figures 1 and 2 is intended to actuate a flow-control valve in a hot water pipe in dependence upon the temperature occurring at a remote point. The apparatus consists essentially of a fluid-filled temperature sensing bulb, an actuator controlling the flow-control valve, and a small bore conduit connecting the sensor and actuator.

The temperature sensor shown in Figure 1 comprises a base plate 10 to one side of which is secured a flexible bellows 11 the other end of the bellows being attached to a plate 12 in fluid-tight manner. Plate 12 is carried by guide rods 13, attached to plate 12 but passing through openings in plate 10; the ends of the rods are attached to a yoke plate 14. A compression spring 15 is arranged between plate 14 and plate 10, and an adjustable stop member 16 threaded into a boss 17 on plate 10, limits, by a shoulder 18 the downward movement of plate 10, by the tension of spring 15, but not the upward movement of the flange in response to fluid pressure within bellows 11. A second flexible bellows 20 is sealed to the under surface of the plate 10, its interior communicating with a bore 21 passing through the plate 10. The bore includes a bleed passage portion 22 which will be in communication with the interior of the bellows 20 controlled by a simple screw-down valve 23. One end of the bore 21 is connected to one end of the pressure conduit 24 extending to the actuator.

The actuator shown in Figure 2 is formed integrally with a water flow-control valve, and comprises a main valve housing 30 formed with an internal wall 31 having a restriction defining a valve seat 32, and a poppet-type valve element 33 having a stem 34 passing through an aperture in the wall 31. A spring 35 acts between this wall and a flange 36 carried by the valve stem, to urge the valve 33 into its open position, between ports 37 and 38. The valve housing is formed to provide a hollow cylindrical cavity 40 on the upper side of the internal wall, and this cavity is closed by a screw-threaded end cap 41. A flexible bellows 42 is mounted within the cavity, one open end of the bellows being secured in fluid-tight manner to the end cap, while the other end is attached to a block 43 formed with a central recess in which fits the end of the valve stem 34.

A small bore drilling 44 through the end cap communicates with the interior of the bellows, and in its open end is fixed a sleeve 45 to act as a connector for the respective end of the pressure conduit 24. A further small bore passageway 46 through the end cap provides communication between the drilling 44 and the internal cavity surrounding the bellows, and a screw-down valve 47 is provided to open or close the passageway as required. The stem of the flow-control valve has a clearance in an aperture in the internal wall 31 and thus water from the pipe can pass into the space 40 surrounding the bellows.

The annular space between the outer bellows 11 and the inner bellows 20 of the sensor is filled with a suitable liquid, for example toluene, before installation. After installation of the sensor and the actuator and the coupling of the actuator into the pipe line in which the heating medium is flowing, the sensor and actuator are connected by means of conduit 24. Screw valve 47 is opened and this admits water from the pipe line 37, 38 to the inside of the valve operating bellows 42 and allows the water to flow along the conduit connected to the inside of the bellows. Air is allowed to escape through the screw valve 23. When all air has been expelled screw valves 47 and 23 are closed.

In operation, a rising environmental temperature will cause expansion of the liquid in the large bellows 11. As the end of this bellows are normally prevented from movement this will cause the small bellows 20 to be compressed and will force water through the conduit to the inside of the actuator bellows 42 causing the bellows to expand and close or partially close the valve 32. Conversely, a falling environmental temperature will cause valve 32 to open.

Adjustment of the stop member 16, by moving plate 10, will vary the pressure within the bellows 11, and thus control the temperature about which the valve 32 operates. If for any reason excessive pressure, which might damage the bellows or other parts of the apparatus, is generated, bellows 11 can expand and move plate 10 against the tension of spring 15.

In an alternative form of the invention, the sensor comprises a base plate to one side of which is secured a thin-walled cylindrical vessel or bulb. Within the bulb a flexible bellows with one open end is also attached to the plate in fluid-tight manner, with the interior of the bellows communicating with a bore passing through the plate. A second smaller pressure adjusting flexible bellows is secured in fluid-tight manner to the opposite side of the plate, its interior communicating with the interior of the first mentioned bellows via the bore, and the movable end of the pressure adjusting bellows is attached to an adjusting block provided with an air bleed passage communicating with the interior of the bellows and controlled by a simple screw-down valve. The block is connected to a screw-threaded adjusting member carried by a bracket secured to the plate. A small bore drilling in the plate intersects the main bore connecting the two bellows and a sleeve fixed in the open end of the drilling provides a connection for the pressure conduit to the actuator.

In the example just described the position of the flow-control valve is dependent partly upon the pressure of the hot water flowing

through the valve, which might cause erratic operation. In the form of actuator shown in Figure 3, the actuator comprises two bellows 50, 51. The bellows are connected at their respective outer ends to plates 52, 53 attached to the outer ends of the valve stem 54, and at their inner ends they are attached to a fixed part of the valve housing 55 as shown. The space inside the respective bellows communicates with the ports 56, 57 in the pipe line and the body is enclosed by an end cap 58 having a through passage 59 for connection to the pressure conduit 61 and is thus normally filled with the transmitting fluid. A passageway 62 between the hot water section and outer surrounding cavity is controlled by a screw-down valve 63.

It will be understood that the temperature sensor need not be of the liquid expansion or vapour pressure type, but may respond, for example, to the thermal expansion of a solid member or consist of a bimetallic element. The actuator also may take forms other than a capsule, or bellows; for example it may comprise a Bourdon tube, or a rubber or like diaphragm. Also, use of the apparatus is not confined to applications where water is used as the heating medium. The conduit may be isolated from the fluid being controlled and filled with water or other suitable transmitting liquid from an alternative source, for example a small hand pump.

WHAT WE CLAIM IS:—

1. A temperature sensitive apparatus comprising a sensor and an actuator and conduit means for joining the sensor and actuator on installation and comprising liquid tight deformable closure walls at the ends of the conduit, one wall being acted on by the sensor and the other being connected to the actuator an opening at each end of the conduit to permit the space between said walls including said conduit to be filled with liquid and means for closing said openings.

2. An apparatus in accordance with claim 1 and comprising coupling means at each end of the conduit to permit connection of the conduit after installation of the sensor and actuator.

3. An apparatus in accordance with either of the preceding claims, wherein said sensor comprises a container for fluid, defined at least in part by one side of a deformable wall member and means defining an enclosure on the other side of the wall member and means for placing said conduit in sealed communication with said enclosure.

4. An apparatus according to any of the preceding claims wherein said actuator comprises a liquid flow control means.

5. An apparatus according to claim 4, wherein said actuator comprises means for admitting liquid from the controlled flow, into the conduit.

6. An apparatus according to claim 4 or 5, wherein the said deformable wall associated with the actuator is subjected to the pressure of the controlled liquid, and comprising hydrostatic balancing means for balancing, on said actuator, the effect of controlled liquid pressure.

7. An apparatus according to claim 6 and comprising means providing a further deformable wall, subjected to the controlled liquid pressure, and means coupling said wall to the actuated element of said actuator.

8. A temperature sensitive apparatus substantially as herein described with reference to the accompanying drawings.

A. A. THORNTON & CO.,
Chartered Patent Agents,
Northumberland House,
303/306 High Holborn,
London, W.C.1.

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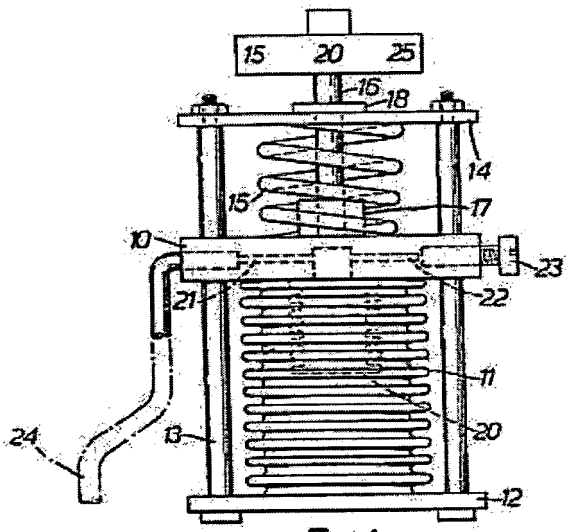

FIG. 1.

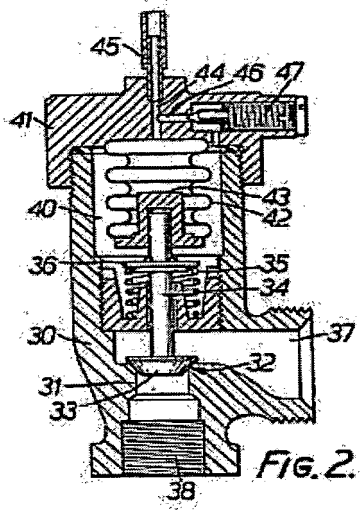

FIG. 2.

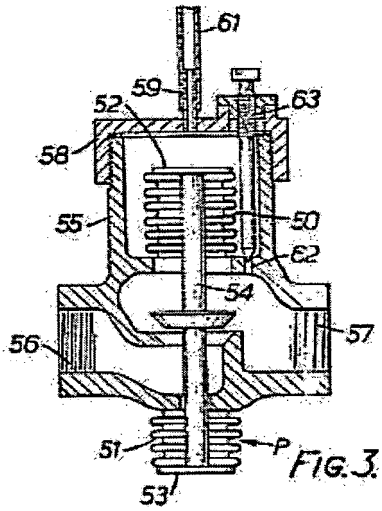

FIG. 3.